

International Journal of Human Sciences Research

Acceptance date: 17/03/2025

FIREWOOD MANAGEMENT DURING THE LATE HOLOCENE IN HUNTER-GATHERER POPULATIONS OF SANTA CRUZ PROVINCE (PATAGONIA, ARGENTINA)

Sebastian Pasqualini

Instituto Nacional de Antropología y
Pensamiento Latinoamericano (INAPL).
3 de febrero 1378 (C 1426BJN). Ciudad
Autónoma de Buenos Aires, Argentina

All content in this magazine is
licensed under a Creative Com-
mons Attribution License. Attri-
bution-Non-Commercial-Non-
Derivatives 4.0 International (CC
BY-NC-ND 4.0).



Abstract: This work is framed within an archaeological theme of hunter-gatherer groups from Santa Cruz province in Southern Patagonia during the last 1000 years BP. The objective is to show the close relationships these human groups maintained with plant resources -especially woody- within a process of climatic change characterized by a drop in relative humidity and regional desiccation. To achieve this, anthracological analyses have been carried out for the taxonomic identification of woody material present in two archaeological sites during this period, which have the characteristic of being hunting blinds. The results indicate that the human groups would have carried out different *logistic strategies* to obtain woody resources. In particular, there is a logistical modality that prioritizes the selection of shrub species from the lowlands of the region, for subsequent transport or hauling to other areas considerably distant within the highlands plateau. This modality in the management of woody resources indicates a type of behavior that has been recurrent over time in the region.

INTRODUCTION

The aim of this work is to characterize the management of woody material by hunter-gatherer groups that inhabited the central western part of the Santa Cruz province (Southern Patagonia) during the last 1000 years BP, approximately. This spatial cut of the province is considered as a meso-region (*sensu* Dincauze, 2000). It is specifically delimited to the north by the Posadas/Pueyrredón and Salitroso lake basins; to the west by the Andes mountain range -which includes the Perito Moreno National Park (hereafter PNPM)-; in the center by the Pampa del Asador and Strobel Lake; to the south by the Cardiel lake basin and finally to the east by the current Route 40 (Figure 1).

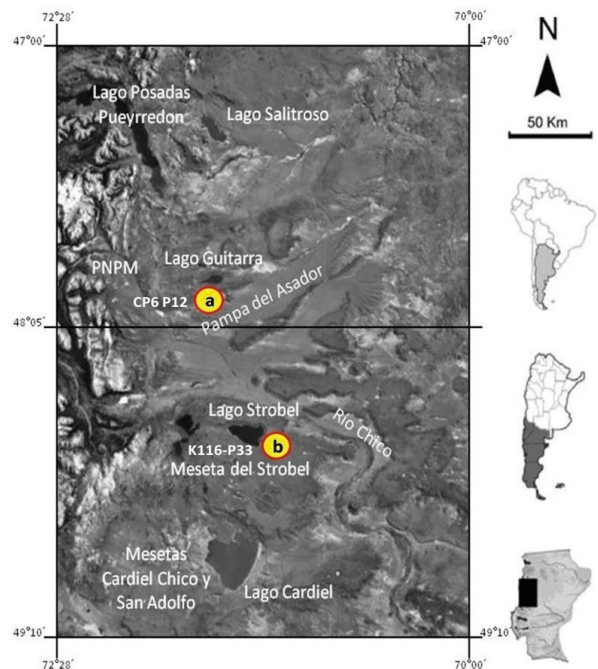


Figure 1. Study region considered.

a) Archaeological site CP6-P12.

b) Archaeological site K116-P33.

The focus will be on the taxonomic identification of woody material found in two archaeological sites located in the highlands of the region (between 900 and 1200 m.a.s.l.). On the one hand, the archaeological site K116 Parapeto 33 (hereinafter K116-P33) located in the Strobel Lake basin and on the other hand, the archaeological site Cerro Pampa 6 Parapeto 12 (hereinafter CP6-P12) located within the Pampa del Asador and near the homonymous hill (Figure 1) will be considered.

Hunting blinds are the most important and frequent open-air site configurations within the study region. In general terms, hunting blinds are rock structures that can be arranged in a straight, semicircular or circular shape, reaching up to 10 m in length. They are usually found in grouped form, but have also been found in isolation (Aragone & Cassiodoro, 2005-2006; Cassiodoro et al., 2016; Dellepiane & Flores Coni, 2016; Goñi, 2010; Goñi et al., 2016; Pasqualini et al., 2016). The first archaeological records of this type of site begin

with the works of Carlos Gradín between 1950 and 1960 in the basin of Cardiel lake and the high plateau of Strobel Lake. This researcher documented more than 100 hunting blinds, which were mainly located on mallines or in peri-lagoon areas. These structures were interpreted as hunting posts in strategic sectors, or as a possible base for awnings (Gradín, 1976). Up to the moment, their number and frequency are increasing with the successive archaeological campaigns in the region. In addition, new interpretative schemes reinforce the idea of hunting blinds as places of hunting posts and where hunting can be programmed under strategies of interception and/or control of prey (Cassiodoro, 2016; Dellepiane, 2019; Dellepiane & Cassiodoro, 2019; Flores Coni, 2018).

Given that the hunting blinds considered for the analysis are located within an environment with phytogeographic characteristics dominated by a wide vegetation cover of grasses, the comparison of their respective results will be considered relevant to complement the information related to the management of woody resources at the regional level, involving other sectors within the same region. At the same time, the late settlement model proposed for the region (Goñi, 2000, 2010) will be taken into account as a reference framework (*sensu* Binford, 2001), which will serve as an interpretative scheme for the results of this work.

THE CURRENT STUDY REGION AND PALEOENVIRONMENTAL SETTING FOR HUMAN OCCUPATIONS

The study region presents a system of plateaus of variable altitude, pampas, a series of large lakes, river basins, canyons, peri-mountains sectors -such as the PNPM- and is considered a vast territory dominated by the semi-desert and steppe (Cabrera & Willink, 1980). One of the particularities that stands out in the region is related to the altitude (Figure 2).

The sectors considered low (below 400 m.a.s.l.), are formed by the current basins of the Posadas/Pueyrredón, Salitroso, Tar, San Martín and Cardiel lakes. These sectors are dominated by a shrub community composed mainly of *Berberis microphylla* G. Forst (calafate), *Schinus marchandii* F.A. Barkley (molle colorado), *Condalia microphylla* Cav. (piquillín), *Colliguaja integerrima* Gilles & Hook (coliguay), *Discaria chacaya* (G. Don.) Tortosa (monte laguna), *Atriplex* sp. (zampa), *Larrea* sp. (jarilla), *Anarthrophyllum rigidum* (Gillies ex Hook. & Arn.) Hieron (mata guanaco), among others.

On the other hand, the sectors considered high (between 900 and 1200 m.a.s.l.) present a series of lake basins such as the Belgrano, Nansen, Azara, Volcán and Burmeister lakes, adjacent to the mountain range sector where the current PNPM is located. There, the Andean *Nothofagus* forest stands out, characterized mainly by arboreal communities of *Nothofagus pumilio* (Poepp. et Endl.) Krasser (lenga) and *Nothofagus antarctica* (G. Forest.) Oerst (ñire), in combination with the herbaceous shrub-steppe (Oliva et al., 2001). The high sectors also include plateaus such as Pampa del Asador, Guitarra and Strobel. In these areas, the low temperature and altitude above sea level are responsible for having a significant snow load, which prevents its habitability during the winter (Cassiodoro, 2011). These areas are characterized by a herbaceous steppe environment (Cabrera, 1971; Paruelo et al., 1992; Soriano, 1956), where includes mainly large areas of *Pappostipa speciosa* grasses. However, there are also patches of low shrub communities such as *Chiliotrichum diffusum* (G. Forest.) Kuntz (black bush), *Lepidophyllum cupressiforme* (Lam.) Cass (green bush), *Mulguraea tridens* (Lag.) N. O'Leary & P. Peralta (black bush), among others. It is precisely the phytogeographic environment where the archaeological sites considered are located.

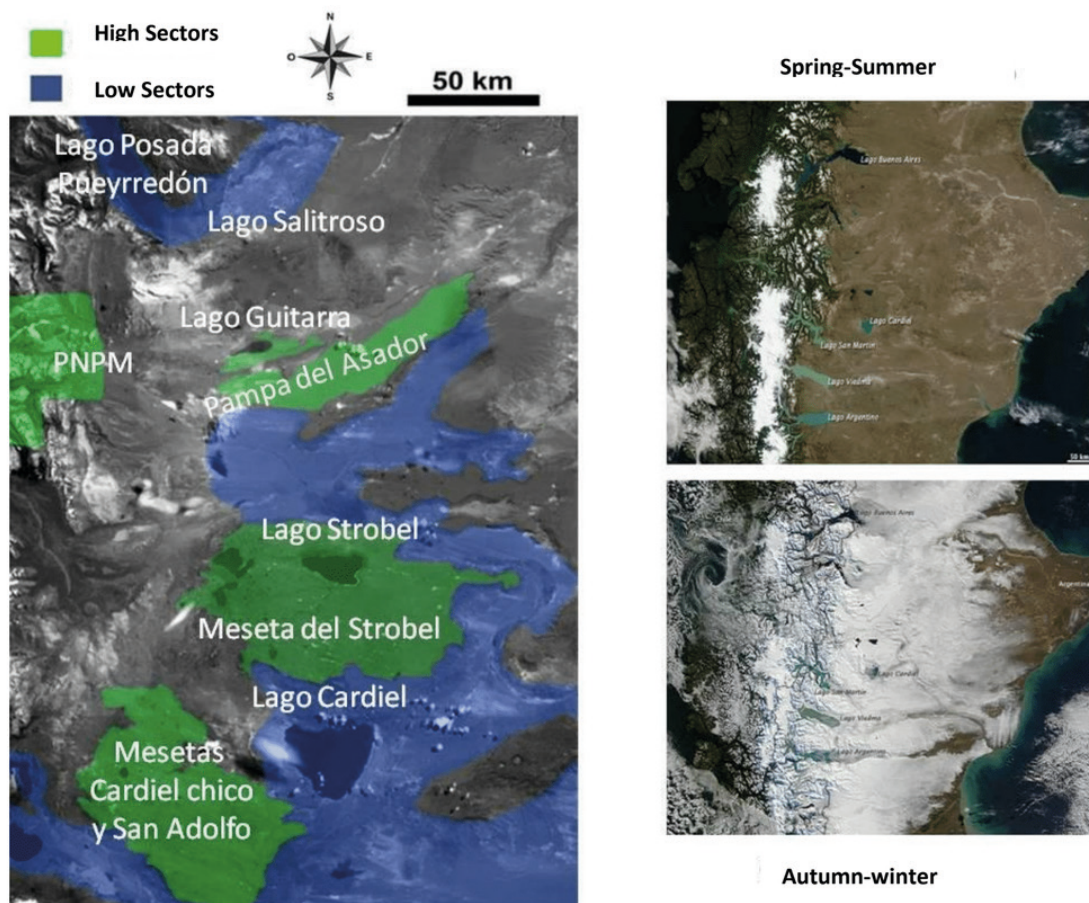


Figure 2. Sectors considered high and low within the study region. Note the marked seasonality.

Considering that this work is framed within the last 1000 years BP, it is important to briefly mention the environmental evolution of the region. Paleoenvironmental studies carried out in Cardiel lake -located within the lower sectors- indicate that during the late Holocene there was a dry period, which included the *Medieval Climatic Anomaly* (MCA) and resulted in a series of hydrological variations in the basin. In this sense, the MCA was characterized in this sector of Patagonia by the existence of prolonged and severe droughts, together with the presence of extreme and abrupt hydrological changes (Stine, 1994). As a consequence, two marked droughts would have been evidenced. The first one between 950 and 860 cal. AP and the second between 700 and 570 years cal. AP, both separated by a somewhat wetter time (Stine & Stine, 1990;

Stine, 1994). Thus, the environmental conditions tending to progressive desiccations from the late Holocene (Stine, 1994), highlighted the extension of a shrub steppe similar to the present (Markgraf et al., 2003) and which were previously described for the lowland sectors. While in the area of the PNPM -located within the high sectors considered for the region-, pollen analysis (Mancini 1998, 2007; Mancini et al., 2002) would indicate that between 2700 and 2000 years BP the maximum development of the discontinuous *Nothofagus* forest occurred, giving rise to the installation and conditions of the present forest.

PATTERN OF HUMAN SETTLEMENT IN THE REGION

Closely linked to the environmental changes of the late Holocene mentioned above, the settlement model proposed for the region focuses on these climatic changes and their influence on the organization of hunter-gatherers (Goñi, 2000, 2010). It proposes that from the last 2500/3000 years BP, the progressive trend towards lower relative humidity within a process of environmental desiccation, the low sectors such as the basins of the Cardiel or Posadas/Salitroso lakes, would have been available due to the expansion of new spaces. This would have implied more benign conditions, resulting in a lower snow load, prey for hunting, raw materials for artifact production, available firewood and reliable water sources. For these reasons, these spaces would have been characterized as residential areas for hunter-gatherers, also associated with a reduction in mobility and a greater population nucleation throughout the year (Cassiodoro, 2011; Goñi & Barrientos, 2004; Goñi & Belardi, 2014, among others).

On the other hand, and in a complementary manner, the highland sectors such as the Pampa del Asador and the Guitarra and Strobel plateaus -which during the winter months are under a significant snow load that prevents their circulation and habitability- would have been used during the summer. In these environments with such a heterogeneously distributed resource structure, there would be spatial and/or temporal incongruities in the acquisition of resources, for which groups would invest more in seasonal and logistical movements (Goñi 2000, 2010). Thus, the interest in these spaces lay in the procurement of animal resources, the search for lithic raw materials in Pampa del Asador, the circulation of information overturned in the rock representations of the Strobel plateau and in the high frequency recorded of hunting blinds (Bar-

rientos et al., 2014; Cassiodoro, 2011; Espinosa & Goñi, 1999; Goñi et al., 2016; Re, 2011, Re et al., 2017; among others). It is worth mentioning that the hunting blinds K116-P33 and CP6-P12 analyzed here are contextualized within this interpretive scheme for the highland sectors.

ARCHAEOLOGICAL RECORD OF THE SITES

The archaeological site K116 is a group of 55 structures located in an extensive plain and about 600 linear meters from the southern margin of Strobel Lake. They are oriented towards the west to protect them from the direction of the prevailing winds and the total area covers about 3 km². Within it, two sectors are differentiated, namely: a sector A -of pampas- that counts 29 hunting blinds and a sector B -of rocky outcrops- that records 26 hunting blinds (Goñi et al., 2016; Re et al., 2017). Within sector B is located K116-P33 (Re et al., 2017) which is part of the analysis for this work (Figure 3) and whose dating is located at 1079 ± 42 radiocarbon years BP (Goñi et al., 2016).



Figure 3. Archaeological site K116-P33.

Morphologically, the arrangement of the rocks in all the hunting blinds shows that the arch shape is the dominant one, followed by semi-arch, linear and circular, with a predominance of chord width of 1 to 3 m. The high quantity of microdebitage, as well as the presence of projectile points (mainly stems) would indicate replacement and reactivation of these artifacts during hunting activities. The

archaeofaunal record comes from the analysis of three hunting blinds. In them, the presence of *Lama guanicoe* (guanaco) stands out, mainly with an abundant presence of sub-adult or immature individuals that reaches 50%. Therefore, based on the archaeological record of these structures and their internal organization, it has been proposed that the site would have been occupied as part of a massive and/or communal hunting episode (Goñi et al., 2016). Thus, the hunting blinds in sector A could have had a functionality characterized for stalking/closing/hunting, while the hunting blinds in sector B could have been used for the general processing of prey.

Cerro Pampa 6 is part of a concentration of 13 hunting blinds located on the western slope of Cerro Pampa and within the Pampa del Asador. From survey work, it was found that these hunting blinds are part of a system arranged in two major groupings (Dellepiane & Cassiodoro, 2019; Goñi et al., 2010-2011, Pasqualini et al., 2016). On the one hand, 8 of them are located in the upper part of the terrain and are part of the so-called sector A. They present on average a dimension of 3.88 m of rope and the distances between them within this group range between 7 and 50 m. On the other hand, 400 meters to the south of this concentration are located the remaining 5 structures that make up the so-called sector B. In this case, the average dimensions are generally larger, reaching 4.5 m in chord. All the structures of the site are semicircular and are also oriented against the prevailing westerly winds. Archaeofaunal analyses were conducted on a total of 904 bones found, which resulted in guanaco as the dominant *taxa*, followed by *Pterocnemia pennata* (choique) (Dellepiane, 2019). In relation to artifacts, debitage is the most represented typological group, along with evidence of stemmed projectile points, cores, retouched flakes, blades, manos and grinding tools (Dellepiane & Cassiodoro, 2019).

Within group B is located CP6-P12, which is part of this work (Figure 4). Its earliest chronology comes from level 5 dated at 886 ± 82 radiocarbon years BP (Cassiodoro & Tessone, 2014; Cassiodoro et al., 2016), which is considered homologous in chronological terms with site K116-P33.



Figure 4. Archaeological site CP6-P12.

SAMPLES AND METHOD OF IDENTIFICATION

In both archaeological sites the woody material was presented in a dispersed form and without evidence of delimited hearths or concentrated material. The sampling strategy or collection of the woody material was carried out with dry sieving of the archaeological sediment and 2 mm light mesh.

Considering particularly site K116-P33, a total of 200 fragments of carbonized woody material have been recovered. These were recovered from a test pit of 50x50 cm side by 50 cm deep. Of these recovered fragments, 50 of them have been indeterminable due to their state of cracking and poor preservation. Therefore, a total sample of 150 fragments has been analyzed and determined from this site. On the other hand, at site CP6-P12 the woody material recovered comes from three 5 cm deep artificial levels and 1 m² grids where all the woody material present was recovered. We have chosen to analyze 250 fragments of woody material for each stratigraphic level, in order to standardize the sampling strategy. Thus, 250 fragments have been analyzed in level 5, as well as 250 fragments in level 4 and finally another 250 fragments in level 2.

To support the process of identification of the woody material used by human groups in the past, we start from the comparison of the anatomical structure of wood known from a collection of current histological, bibliographic and/or carbonized reference in plant anatomy. For this work we used different anatomical atlases of southern Patagonia available in the bibliography, which, given the regional geographical affinity, were adequate. These were Ancíbor & Pérez de Micou (2002) and Caruso Fermé (2013). In turn, we also have our own current carbonized reference collection, which can be found in Pasqualini (2022).

Each fragment of woody material recovered was subjected to manual fracture to ensure the three anatomical planes of microscopic observation (Transversal Section, Tangential Longitudinal Section and Radial Longitudinal Section). The main anatomical features observed under the microscope were ring demarcation, porosity, arrangement and orientation of vessels, types of rays, height and thickness (measured in ray cells), heterogeneity or homogeneity of the radial system, presence of vascular punctuations, type of wall, perforation plate, among other features (taken from the list of diagnostic characters of IAWA, 1989). In addition, each fragment of the archaeological charred woody material was determined at the species, genus or kindred level as appropriate. Finally, for the visualization of these diagnostic features, an optical microscope with incident light at magnifications up to 400x was used in combination with the Scanning Electron Microscope (SEM) to obtain images at higher magnifications.

RESULTS

The total amount of charred woody material analyzed is 900 fragments, of which 150 come from site K116-P33 (17%) and 750 from site CP6-P12 (83%) (Table 1). As can be seen, the determinations have been reached at the level of genus (sp.), kindred, species and Indeterminate elements. Considering all the elements determined in both sites, a total of 9 *taxa* have been identified, of which two of them have been assigned to tree species present in the forest and led by *Nothofagus* sp. (2.5%) and *Nothofagus pumilio* (1.3%). The remaining 7 *taxa* have been assigned as shrub species typical of the steppe of the region, consisting of *Mulguraea tridens* (32%), followed by *Chilietrichum difussum* (19.8%), *Berberis* sp. (18.5%), *Schinus* sp. (15.7%), *Colliguaja integerrima* (3.6%), *Lepidophyllum cupressiforme* (2.7%), *Discaria chacaye* (2.5%) and finally indeterminate elements that reach 0.3% of the total sample analyzed.

Considering the particular results of the hunting blind K116-P33, it can be observed in Table 1 that *Chilietrichum difussum* is the most represented *taxa* reaching 31% of the determined material (n: 47), followed by *Mulguraea tridens* with 19% (n: 28) (Figure 5), *Lepidophyllum cupressiforme* with 17% (n: 25), *Discaria chacaye* with 15% (n: 23) and *Berberis* sp. with 2% (n: 3). Based on these results, all these *taxa* are typical of the regional shrub steppe and were part of some combustion present in the survey conducted. However, the presence in this hunting blind of 15% carbonized elements of *Nothofagus* sp. (n: 23) indicates that a woody typical of the peri-mountain *Nothofagus* forest was also incorporated. This last *taxa* has been assigned to genus level because there are ambiguous diagnostic elements for its determination, i.e., it could correspond to the species *pumilio* or *antarctica* given the geographic linkage.

Taxon	K116-P33		CP6-P12						Total Sites	
	Probe		Level 5		Level 4		Level 2			
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%
1. <i>Nothofagus pumilio</i>	–	–	12	5%	–	–	–	–	12	1,3%
2. <i>Nothofagus</i> sp.	23	15%	–	–	–	–	–	–	23	2,5%
3. Related to <i>Chiliotrichum diffusum</i>	47	31%	15	6%	48	19%	69	28%	179	19,8%
4. Akin to <i>Discaria chacaye</i>	23	15%	–	–	–	–	–	–	23	2,5%
5. Related to <i>Mulguraea tridens</i>	28	19%	36	14%	117	47%	112	45%	293	32,5%
6. Akin to <i>Lepidophyllum Cupressiforme</i>	25	17%	–	–	–	–	–	–	25	2,7%
7. <i>Berberis</i> sp.	3	2%	164	66%	–	–	–	–	167	18,5%
8. <i>Schinus</i> sp.	–	–	21	8%	52	21%	69	28%	142	15,7%
9. <i>Colliguaja integerrima</i>	–	–	–	–	33	13%	–	–	33	3,6%
10. Undetermined	1	1%	2	1%	–	–	–	–	3	0,3%
Subtotal	150		250		250		250			
Total	900									

Table 1. Taxa determined at sites K116-P12 and CP6-P12.

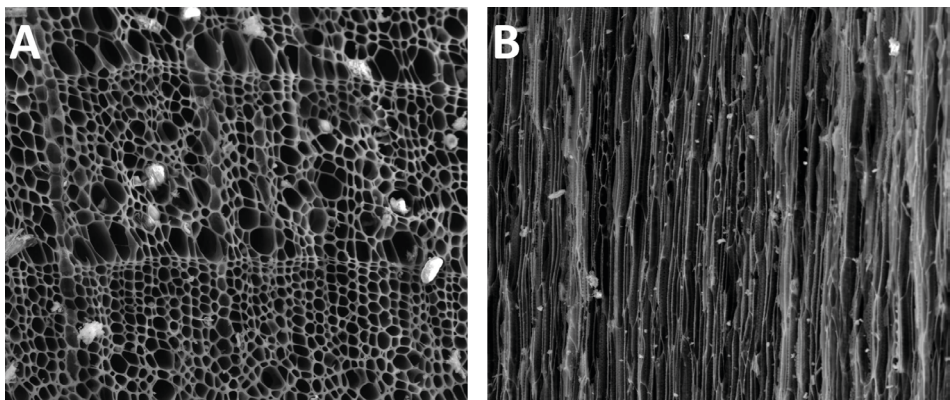


Figure 5. *Mulguraea tridens* present in the hunting blind K116-P33. A: Transversal plane at 800 magnification, where demarcated rings and vessels can be observed in isolation and grouped in short radial and oblique series. B: Tangential plane at 400 magnification where heterogeneous uniseriate rays of 1 to 5 cells in height can be observed.

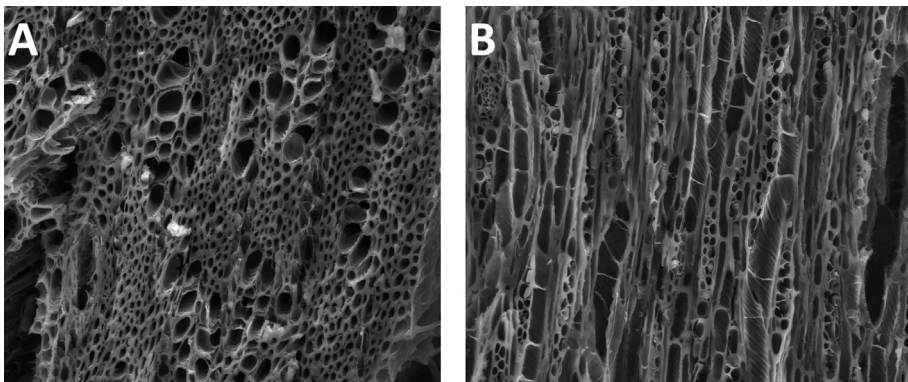


Figure 6. *Schinus* sp present in hunting blind CP6-P12. A: Transverse plane at 800x magnification showing demarcated rings and vessels grouped radially in a dendritic pattern. B: Tangential plane at 800 magnification showing uniseriate and multiseriate rays 2 to 4 cells wide and walls with spiral thickening.

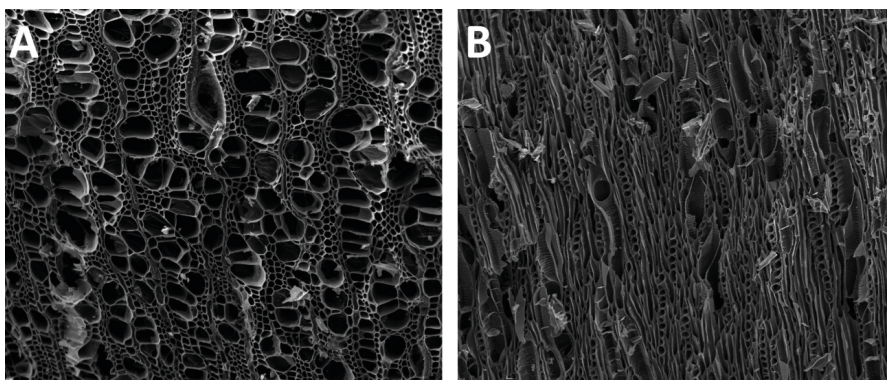


Figure 7. *Nothofagus pumilio* present in hunting blinds CP6-P12. A: transverse plane at 400 magnification where a diffuse porosity and vessels grouped radially from 2 to 6 vessels can be observed. B: Tangential plane at 400 magnification showing well homogeneous uniseriate rays of 5 to 20 cells in height, spiral thickenings and simple perforation plates well visible.

Considering the hunting blind CP6-P12, Table 1 shows that level 5 (n: 250) is represented by *Berberis* sp. leading the determinations with 66% (n: 164), followed by *Mulguraea tridens* with 14% (n: 36), *Schinus* sp. with 8% (n: 21) (Figure 6), *Chiliotrichum difussum* with 6% (n: 15) and finally *Nothofagus pumilio* with 5% (n: 12) (Figure 7). On the other hand, level 4 (n: 250) is represented mostly by *Mulguraea tridens* with 47% (n: 117), followed by *Schinus* sp. with 21% (n: 52), *Chiliotrichum difussum* with 19% (n=48) and *Colliguaja integerrima* with 13% (n: 33). Finally, level 2 (373±45 radiocarbon years BP) (n: 250) has been assigned within a sub-current period and evidences that *Mulguraea tridens* continues to be mostly represented with 45% (n: 112), followed by *Chiliotrichum difussum* and *Schinus* sp. with 28% in both cases (n: 69). As can be seen, carbonized elements from both the shrub-steppe and the forest are also present at this site, as evidenced by *Nothofagus pumilio* in level 5.

DISCUSSION

Within the variability of *taxa* recognized in the determinations of both sites, a series of patterns have been detected in the archaeological record (*sensu* Binford 2001), for which we will try to give an explanation. These patterns have to do, in the first place, with the incongruent or anomalous presence of woody material within the highland sectors such as Pampa del Asador/Cerro Pampa and the Strobel plateau. Secondly, with the presence of low shrubs within the studied hunting blinds.

In relation to the first point, the presence of charred elements of *Nothofagus* sp. within the hunting blind K116-P33 we considered it as anomalous or incongruent. The reason for this lies in the fact that this site, located within high altitude plateau areas, is about 100 km to the east of the *Nothofagus* forest. Seen in these terms, their acquisition could have occurred in the peri-mountain sector of the Andes (*Nothofagus* forest) to be used as fuel material within the hunting blind. Or, it could be that these fragments are part of the combustion residues of some artifact made from this tree. Whatever the case, the presence of these woody remains inside the hunting blind gives to *Nothofagus* an allochthonous character in the Strobel Lake basin. Moreover, woody material from the forest is also present in the hunting

blind CP6-P12. In this case, carbonized elements of *Nothofagus pumilio* also acquire an incongruous role in Pampa del Asador/Cerro Pampa -which is characterized by a wide supply of grasses and low shrubs-. In this case, the site is located about 75 linear km east of the peri-mountain sector of the forest.

This is remarkable into the discussion, because what is being proposed is the human groups of the region approximately 1000 years BP would have had mobility strategies that involved circuits to and from the forest. This can be sustained by documentary sources. Thus, we can mention George Musters in his trip through the Santa Cruz province in 1869 and who, on the occasion of being accompanied by a group of Tehuelches states: "*Casimiro proposed that I accompany him to the forests to cut sticks for the awnings and wood to make saddles...*" (Musters 1964, p. 125). Or the mention that José María Cual makes about the Tehuelche "toldos" where he reports that "*The stakes were brought from the mountain range*" (Bórmida and Casamiquela 1958/69, p.170). In this way, it would be attested that the main source of arboreal resources for the historical Tehuelches is available and in supply in the *Nothofagus* forest.

Within this same scheme, the presence of *Schinus* sp. on the hunting blind CP6-P12, approximately 1000 years BP, is also considered incongruous or anomalous. One of the possible explanations for this argument could be due to the fact that *Schinus* (molle) communities are widely in supply within the lowland sectors of the region, such as the basins of Pueyrredón/Posadas, Salitroso and Cardiel lakes, and null in the highland sectors where this hunting blind is located

Again, the documentary sources have provided information about the importance that this shrub could have had for the native populations during historical times. For instance, Escalada (1949) on the occasion of his classification of the "*Complejo Tehuelche*" notoriously mentions a group near the Buenos Aires lake,

which is called *Métcharnue* or "*people of the resin or of the molles*". This is not a minor fact, not at all. It was also Musters who recorded a very particular practice: "*...chewing Maki, a gum that exudes from the incense bush, and which the women and children carefully collect...*" (Musters 1964, p.191). On the other hand, José María Cual would relate the following in relation to the use of wood used for the cradles in cranial deformation: "*Molle wood was used for the cradle. Cane was also used*" (Bórmida and Casamiquela 1958-1969, p. 168-169). On the other hand, this same person details the way in which the lithic pieces were sleeved "*...by means of a mixture of molle resin with paint earth (any) and grease*." (Bórmida and Casamiquela 1958-1969, p. 168-169). From this, it is firmly sustained that *Schinus* (molle) would have a transcendental and omnipresent role in the life of the human groups of the region, at least since the late Holocene, when we have strong evidence of its use in the highland sectors of the region. And if we consider the archaeofaunal and lithic evidence present in the hunting blinds would reflect guanaco processing activities (Goñi et al., 2016; Dellepiane, 2019; Dellepiane & Cassiodoro, 2019), it would not be surprising the woody material reflected fuel activities for the hunter-gatherers.

In relation to the second point detected as a pattern in the archaeological record of the sites studied, Table 1 allowed us to highlight that *Mulguraea tridens* and *Chiliotrichum difussum* lead the determinations made for both hunting blinds, respectively. This fact is consistent with the current local supply and availability of these shrubs in the Guitarra plateau, Cerro Pampa and the Strobel Lake basin. In turn, shrubs such as these would also have been widely available for acquisition by hunter-gatherers during at least much of the middle Holocene, according to regional pollen records (Markgraf et al., 2003; Mancini, 1998, 2007; Mancini et al., 2002). Proof of this is also the presence of *Mulguraea tridens*

and *Chiliotrichum difussum* in an archaeological site assigned to the middle Holocene of Lake Guitarra (Pasqualini, 2022). That is, both shrubs are recorded in pollen and anthracological analyses of the middle Holocene.

However, what is striking is that both shrubs are not optimal elements as fuel for cooking, because large quantities of them are needed for it. However, the main qualities of the verbenaceae (bushes) are to provide a fast, efficient ignition and the production of abundant smoke. This feature has been detected in many opportunities by ourselves in highlands. Therefore, another explanation have to be necessary to justify their presence in these hunting blinds sites. One of the possible explanations that fits better to understand their record could be the use of verbenaceae as a form of communication between hunters, by means of smoke signals. And this would have occurred during the late Holocene, or at least in the last 1000 years BP, which is when there is an accurate record of their use in the hunting blinds.

Documentary sources could shed light in this regard. For example, in the extreme south region of Santa Cruz (Cabo Virgenes), De Loqui (1992) by himself corroborates the qualities of these bushes when he describes them as “telegraph” in the following passage: “*I was a kilometer and a half from the camp and...I put our telegraph into practice, making smoke from mata negra. A quarter of an hour later two peons arrived...*” (De Loqui 1992, p. 52). Also, we cannot fail to mention a very particular detail observed by Moreno in the same province when he describes “*the dark verbenacea*” as follows: “*...even when those fumes are sometimes distinguished so distant and so faint that they indicate a distance of several tens of leagues between those who have lit them and the one who spots it.*” (Moreno 2007, p.138). This passage not only mentions the use of this wood as a method of communication, but also gives us the information that the divisible distance of this practice involves leagues of distance.

Following this reasoning, it is valid to think that the use of a hunting blind could have involved -indefinitely- a certain kind of communication among the hunters to carry out logistical tasks in order to stalking and hunting guanacos. And one of the most effective forms of communication in such an enormous and open plateaus -where visibility reaches the horizon in large part- would have been to produce smoke signals by burning fresh verbenaceae. A data in favor of this argument is given by the very low frequency recorded of thermoaltered elements in guanaco bones from other K116 hunting blinds (Goñi et al., 2016). In other words, low frequency of thermoaltered elements in bones is an indicator that the faunal remains for consumption would not evidence episodes of frequent combustion for cooking. Therefore, the most parsimonious hypothesis to explain the presence of verbenaceae in these hunting blind sites, necessarily have to be the communication between hunters by means of smoke signals.

All mentioned above is important for the settlement model proposed for the region (Goñi 2000; 2010) and adds additional information to it. The anthracological record of the sites studied in this work suggests that the presence of woody material would be consistent with the logistical activities carried out in the highland sectors of the region. In other words, the charred woody material found in archaeological contexts would have accompanied hunting activities in the highland areas during the late Holocene. This would have implied the transfer of firewood from the *Nothofagus* forest and *Schinus* sp. from the adjacent lowlands. This would imply a *logistical planning* by the hunters as a way of securing these large woody species in the absence of them in the highland areas. Thus, the logistical planning, seen in these terms, would imply the provision and transport of firewood from distant points.

Finally, the main goal of this article has been to show the close relationships that these human groups would have maintained with woody plant resources within a process of regional desiccation for the last 1000 years BP. In addition, data from other archaeological sites within the region show that shrubs such as *Atriplex* sp. -a woody plant highly adapted to arid and saline environmental conditions- was only found and exclusively in the late Holocene period (Pasqualini, 2022).

CONCLUSIONS

It has been proposed to evaluate the management of firewood in two hunting blinds during the last 1000 years BP and under a process of climatic fluctuations tending to a decrease in relative humidity and a process of environmental dryness. Considering the paleoenvironmental context and based on the woody samples analyzed from two hunting blinds, we proposed that human groups have managed vegetal resources in an articulated manner between the *Nothofagus* forest and the shrub steppe in conditions of marked seasonality within the region.

REFERENCES

- Ancibor, E. & Pérez de Micou, C. (2002). Reconocimiento de especies vegetales combustibles en el registro arqueológico de la estepa patagónica. En: C. Pérez de Micou (Ed.), *Plantas y cazadores en Patagonia* (pp. 15-32). Buenos Aires, FFYL, Universidad de Buenos Aires.
- Aragone, A. & Cassiodoro, G. (2005-2006). Los parapetos de Cerro Pampa: registro arqueofaunístico y tecnológico (noroeste de la provincia de Santa Cruz). *Arqueología* 13 Pp.:131-154.
- Barrientos, G., García Guraieb, S., Del Papa, M. & Durou, G. (2014). La estructura regional del registro bioarqueológico del área de los lagos Cardiel y Strobel. En: R. Goñi, J. Belardi, G. Cassiodoro, & A. Re, (Eds.), *Arqueología de las cuencas de los lagos Cardiel y Strobel. Poblamiento humano y paleoambientes en Patagonia* (pp. 117-134). Buenos Aires, Aspha ediciones.
- Binford, L. (2001). *Constructing Frames of References*. Berkeley, University of California Press.
- Bórmida, M. y Casamiquela, R. (1958-1959). Etnografía Gününa-Këna. Testimonio del último de los tehuelches Septentrionales. *Runa: Archivo para las Ciencias del Hombre*, IX, 153-193.
- Cabrera, A. (1971). Fitogeografía de la Argentina. *Boletín de la Sociedad Argentina de Botánica*, XIV (1-2), 1-43.
- Cabrera, A. & Willink, A. (1980). Biogeografía de América Latina. Secretaría General de la Organización de Estados Americanos. *Monografía 13, Serie de Biología*. Washington.

To conclude, this work tested at least two *logistical strategies* for the management of woody material. The first logistical strategy is the acquisition of woody material from lowland areas, which is then transported several tens of kilometers to highlands plateaus such as the Pampa del Asador/Cerro Pampa and the Strobel Lake basin -as a form of fuel reinsurance-. The second logistical strategy detected would be related to a specific use of verbenaceae on hunting blinds, which could have had a function oriented towards communication among the hunters by means of smoke signals.

ACKNOWLEDGMENTS

This work was supported by Instituto Nacional de Antropología y Pensamiento Latinoamericano (INAPL), Leonor Acuña, Rafael Goñi and his team. I would like to thank the collaboration of Ramón Castillo and Adriana Domínguez from Comisión Nacional de Energía Atómica (CNEA). A special thanks to Silvia Griffin and Sasha for their support. Finally, thanks to Maga, Tigra and the committee of this journal for helping with this manuscript.

Caruso Fermé, L. (2013). *Los Recursos Vegetales en Arqueología: Estrategias De Muestreo Y Estudio Del Material Leñoso*. Buenos Aires, Dunken.

Cassiodoro, G. (2011). Movilidad y uso del espacio de cazadores-recolectores del Holoceno tardío: estudio de la variabilidad del registro tecnológico en distintos ambientes del noroeste de la provincia de Santa Cruz. *South American Archaeology Series 13, British Archaeological Reports (International Series)*. Oxford, Archaeopress.

Cassiodoro, G. (2016). Paisajes mesetarios en Patagonia: Tecnología de Pampa del Asador-lago Guitarra (Santa Cruz). *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano* 25 (2) Pp.: 119-140 (2016).

Cassiodoro, G. & Tessone, A. (2014). Análisis radiocarbónico y de isótopos estables en residuos cerámicos del centro oeste de Santa Cruz (Patagonia). *Relaciones de la Sociedad Argentina de Antropología*, 39 (1), 293-299.

Cassiodoro, G., Goñi, R. & Pasqualini, S. (2016). Variabilidad del registro arqueológico en sectores altos de Santa Cruz: tendencias generales en el uso del espacio. En F. Mena (Ed.), *Arqueología de la Patagonia: de mar a mar*. (pp. 224- 234). Ediciones Ñire negro, Santiago de Chile.

De Loqui, T. (1992). *Una expedición al Cabo Vírgenes*. Ediciones Marymar, Colección Patagonia, Buenos Aires (1992).

Dellepiane, J. (2019). *Poblamiento y uso del espacio de sectores mesetarios del centro-oeste de Santa Cruz durante el Holoceno tardío. Una aproximación zooarqueológica*. (Tesis de doctorado inédita), Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.

Dellepiane, J. & Flores Coni, J. (2016). Aspectos tecnológicos y faunísticos en sitios a cielo abierto: variabilidad del registro en los parapetos de la meseta del Strobel, Provincia de Santa Cruz. En: F. Mena (Ed.), *Arqueología de la Patagonia: de mar a mar*. (pp. 245- 255). Ediciones Ñire negro, Santiago de Chile.

Dellepiane, J. & Cassiodoro, G. (2019). ¿Estructuras de caza o campamentos temporales? Registro arqueológico de parapetos del sitio Cerro Pampa 6 (Santa Cruz). En: *Arqueología de Patagonia: el pasado en las arenas*, editado por J. Gómez Otero, A. Svoboda y A. Banegas, Pp.: 361-372. Instituto de Diversidad y Evolución Austral, Puerto Madryn.

Dincauze, D. (2000). *Environmental Archaeology, Principles and Practices*. Cambridge University Press.

Escalada, F. (1949). *El Complejo "Tehuelche". Estudios de Etnografía Patagónica*. Buenos Aires, Instituto Superior de Estudios Patagónicos.

Espinosa, S. y Goñi, R. (1999). ¡Viven!: una fuente de obsidiana en la provincia de Santa Cruz. *Actas de las III jornadas de Arqueología de Patagonia. Soplando en el Viento* (pp. 177-188). Neuquén-Buenos Aires.

Flores Coni, J. (2018). *Poblamiento humano y uso del espacio en la meseta del Strobel (provincia de Santa Cruz). Un análisis sobre la variabilidad tecnológica durante el Holoceno*. (Tesis de doctorado inédita), Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.

Goñi, R. (2000). Arqueología de momentos históricos fuera de los centros de conquista y colonización: un análisis de caso en el sur de la Patagonia. En: *Desde el País de los Gigantes. Perspectivas Arqueológicas en Patagonia*. (pp. 283-296). UNPA, Río Gallegos.

Goñi, R. (2010). *Cambio climático y poblamiento humano durante el Holoceno tardío en Patagonia meridional. Una perspectiva arqueológica*. (Tesis de doctorado inédita), Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.

Goñi, R. & Barrientos, G. (2004). Poblamiento tardío y movilidad en la cuenca del lago Salitroso. En Civalero, M., Fernández, P. & Guráieb, A. (Eds.), En: *Contra Viento y Marea. Arqueología de Patagonia* (pp. 313-324). Buenos Aires, INAPL-SAA.

Goñi, R. & Belardi, J. (2014). El proyecto de arqueología de los lagos Cardiel y Strobel. El poblamiento de la estepa santacruceña. En: Goñi, R., Belardi, J., Cassiodoro, G. & Re, A. (Eds.), *Arqueología de las cuencas de los lagos Cardiel y Strobel. Poblamiento humano y paleoambientes en Patagonia* (pp. 17-29). Buenos Aires, Aspha ediciones.

Goñi, R., Cassiodoro, G. & Rindel, D. (2010-2011). Poblamiento de mesetas: arqueología de pampa del asador y cerro pampa (Patagonia meridional). *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano*, 23 (1), 21-36.

Goñi, R., G., Cassiodoro, J., Flores Coni, J., Dellepiane, A., Agnolin & Guichón, R. (2016). Estrategias de caza y movilidad. Parapetos del sitio K116 (Meseta del Strobel, Santa Cruz). En: *Arqueología de la Patagonia: de mar a mar*. (pp. 441-449). Ediciones Ñire negro, Santiago de Chile.

Gradín, C. (1976). Parapetos de piedra y grabados rupestres de la meseta del lago Buenos Aires. Actas y Memorias IV Congreso Nacional de Arqueología Argentina. *Revista del Museo Historia Natural de San Rafael, Mendoza*. Pp.: 315-337.

IAWA, (1989). List of microscopic features for hardwood identification. E.A. Wheeler, P. Baas & Grason (Eds.). 1989. *IAWA Bull.* 10 Pp.: 219-332

Mancini, M. (1998). Vegetational changes during Holocene in the Extra-Andean Patagonia, Santa Cruz Province, Argentina. *Palaeogeography, Palaeoclimatology, Palaeoecology* 138 (1-4), 207-219.

Mancini, M. (2007). Cambios paleoambientales en el ecotono bosque-estepa: Análisis polínico del Sitio Cerro Casa de Piedra 7, Santa Cruz (Argentina). En: Morello, F., Martinic, M., Prieto, A., & Bahamonde, G. (Eds.). *Arqueología de Fuego-Patagonia* (pp. 89-93). Punta Arenas, CEQUA.

Mancini, M., Páez, M. & Prieto, A. (2002). Cambios paleoambientales durante los últimos 7000 14C años en el ecotono bosque estepa, 47-48° S, Santa Cruz, Argentina. *Ameghiniana*, 39 (2), 151-162.

Markgraf, V., Bradbury, J., Schwalb, A., Burns, S., Stern, C., Ariztegui, D., Gilli, A., Anselmetti, F., Stine, S. & Maidana, N. (2003). Holocene palaeoclimates of southern Patagonia: limnological and environmental history of Lago Cardiel, Argentina. *The Holocene* 13 (3), 597-607.

Musters, G. (1964). *Vida entre los Patagones: Un año por tierras no frecuentadas, desde el Estrecho de Magallanes hasta el Río Negro*. Buenos Aires, Solar, (original de 1869).

Oliva, G., González, L., Rial, P. & Livraghi, E. (2001). El ambiente en la Patagonia Austral. En: Borrelli, P. & G. Oliva (Eds.), *Ganadería Ovina sustentable en la Patagonia austral. Tecnología de Manejo Extensivo* (pp.19-83). Buenos Aires, PRODESAR, INTA-GTZ.

Pasqualini, S. (2022). *Gestión de recursos leñosos entre cazadores-recolectores de diferentes espacios altitudinales y ecológicos de Patagonia Centro-Oeste a partir del Holoceno medio. Una perspectiva arqueológica/antracológica*. (Tesis de doctorado inédita), Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.

Pasqualini, S., G. Cassiodoro & Dellepiane, J. (2016). Logistical mobility in plateaus in central-western Santa Cruz, Argentina. An anthracological, technological and archaeofaunal approach. *Quaternary International* 422 (2016) Pp.: 135-151.

Paruelo, J., Aguilar, M., Golluscio, R. & León, R. (1992). La Patagonia extrandina. Análisis de la estructura y el funcionamiento de la vegetación a distintas escalas. *Ecología Austral*, (2) 123-136.

Re, A. (2011). *Representaciones rupestres en mesetas altas de la provincia de Santa Cruz. Circulación de información en espacios de uso estacional*. (Tesis de doctorado inédita), Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.

Re, A., Goñi, R., Flores Coni, J., Guichón, F., Dellepiane, J. & Umaño, M. (2017). Arqueología de la meseta del Strobel (Patagonia meridional): 15 años después. *Relaciones de la Sociedad Argentina de Antropología*, XLII (1), 33-158.

Soriano, A. (1956). Los distritos florísticos de la Provincia Patagónica. *Revista de Investigaciones Agrícolas* X (4), 23-347.

Stine, S. (1994). Extreme and persistent drought in California and Patagonia during mediaeval time. *Nature*, (369), 546-549.

Stine, S. & Stine, M. (1990). A record from Lake Cardiel of Climate Change in Southern America. *Nature* (345), 705-708.